

# THE INTERNATIONAL AIRCRAFT FIRE AND CABIN SAFETY RESEARCH CONFERENCE

## SAE A-22 AND AS6826 STATUS

June 2023

**A-22 Powerplant Fire Protection and Flammability Testing Committee**

Co-Chairs: John Ostic (Boeing) & Daniel Laborie (GE)

Secretary: Brian Stewart (Spirit AeroSystems)



## Abstract

This presentation will brief the aerospace fire safety community on the activities of SAE A-22 Fire Protection and Flammability Testing Committee. The A-22 Committee was chartered in 2018 to address the FAA's Tasking Request to develop industry standards to be used as the basis for an updated FAA Advisory Circular AC20-135. Regulatory and Industry representatives had expressed a need to update the content of the AC, and wide variations in fire test approaches and pass/fail criteria had developed over time across the industry. The AS6826 Powerplant Fire Test Standard currently in development will provide fire test methodologies and pass/fail criteria that have been found to be acceptable by the Regulatory Authorities to meet the applicable propulsion system component and powerplant installation fire protection requirements. The A-22 Committee is also developing standards to address fire safety for engine combustor burn-through, engine mounts, and electrical wiring interconnection systems.

## SAE A-22: Background and Purpose

The SAE A-22 Fire Protection and Flammability Testing Committee was initially formed in March 2018 to support the update of FAA AC20-135. The committee is comprised of individuals from across the industry including aviation certification authorities. The committee is responsible for creating and maintaining technical standards pertaining to acceptable means of testing aircraft and propulsion system components and their installations (CFR/CS 23, 25, 27, 29, and 33). The committee works with regulatory authorities to ensure that the standards developed support certification requirements across the globe. While the initial task was to improve upon the existing AC20-135 powerplant installation fire test standard, the scope has grown to include harmonizing test methodologies, developing recommended practices, and maintaining other test standards.

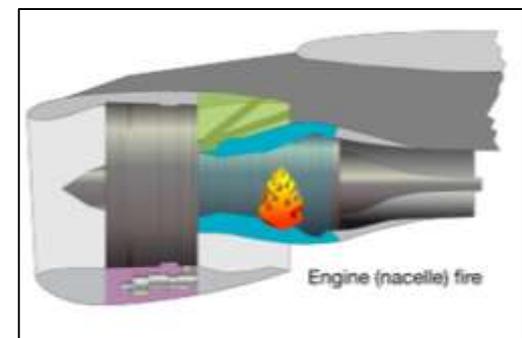
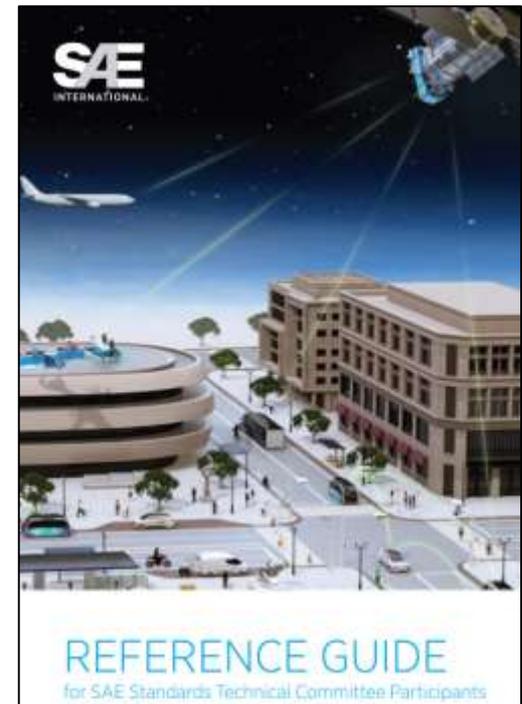


Image Courtesy of Airbus

# SAE A-22 Committee Objectives and Initial Program of Work

The objectives of the committee are to:

- Develop and publish SAE Technical Reports for testing of fire protection systems, components, and structure
- Define test requirements for aircraft and propulsion systems
- Develop performance standards for certification testing of aircraft and propulsion systems
- Define the sensitivities and accuracy of equipment used to conduct fire and flammability testing
- Harmonize global testing methodologies

## INITIAL PROGRAM OF WORK

Develop SAE standards or recommended practices to address the FAA Tasking Request to develop industry standards to update AC20-135, *Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria*. The proposed standards will be used to demonstrate compliance with powerplant fire protection requirements. In addition, methods used to calibrate and set-up a new sonic burner as an optional replacement for existing fire test burners will be developed.

2016 Original Top 10 Industry Needs	
1	Post-Test Burning & Backside Ignition
2	Burner & Flame Temperature
3	Flame Calibration
4	Definitions: Fireproof, Fire-Resistant, Heat Flux
5	Test Pass/Fail Criteria including TSO hoses
6	Thermocouples (Size, Type, Number)
7	Environment and Operating Conditions
8	Panel Size
9	Materials
10	Harmonize with Other Specifications and References

# SAE A-22 Committee Participants

Current SAE Roster Includes ~200 Participants from Industry and Regulatory Authorities

- Consistent and Meaningful Support from FAA, EASA, TCCA, and ANAC

## Airplane Mfg.

Airbus  
Boeing  
Bombardier  
Boom Supersonic  
COMAC  
Dassault  
Embraer  
Gulfstream  
Heart  
Mitsubishi  
Textron/Cessna  
Turkish Aerospace

## Engine Mfg.

GE  
Honeywell  
Pratt & Whitney  
Rolls-Royce  
SAFRAN



Transport  
Canada

## Helicopter Mfg.

Airbus  
Bell/Textron  
Sikorsky/Lockheed

## Certification Authorities

Brazil (ANAC)  
Canada (TCCA)  
China (CAAC)  
Europe (EASA)  
Israel (CAAI)  
United States (FAA)



## Component Mfg.

Air Liquide Tech  
Akro Fire  
Eaton  
JPR Hutchinson  
Meggitt  
Luxfer MEL Tech.  
Parker  
Titeflex  
Trelleborg  
Triumph  
Unison Industries

## MRO Engineering

MHIRJ

## Government Institutions

FAA Tech Center  
Naval Air Systems Command (NAVAIR)  
National Research Council (Canada)  
ONERA (France)

## Academia/Research

Concordia Univ. Montreal  
Rescoll (Bordeaux Univ.)  
University of Cincinnati  
Wichita State University



## Industry Consultants

Danker Associates  
GE Aviation  
Marlin Engineering  
Nacelle Group  
Waldron Aerosystems  
Gordon & Gordon Engineering



## Commodity Manufacturers

AIM Altitude  
GKN  
Safran Nacelles  
Spirit AeroSystems  
RTC/PW/UTC/Collins  
ST Engineering  
Zodiac Aerospace

## Standards Org.

NACE  
SAE



## Testing Facilities

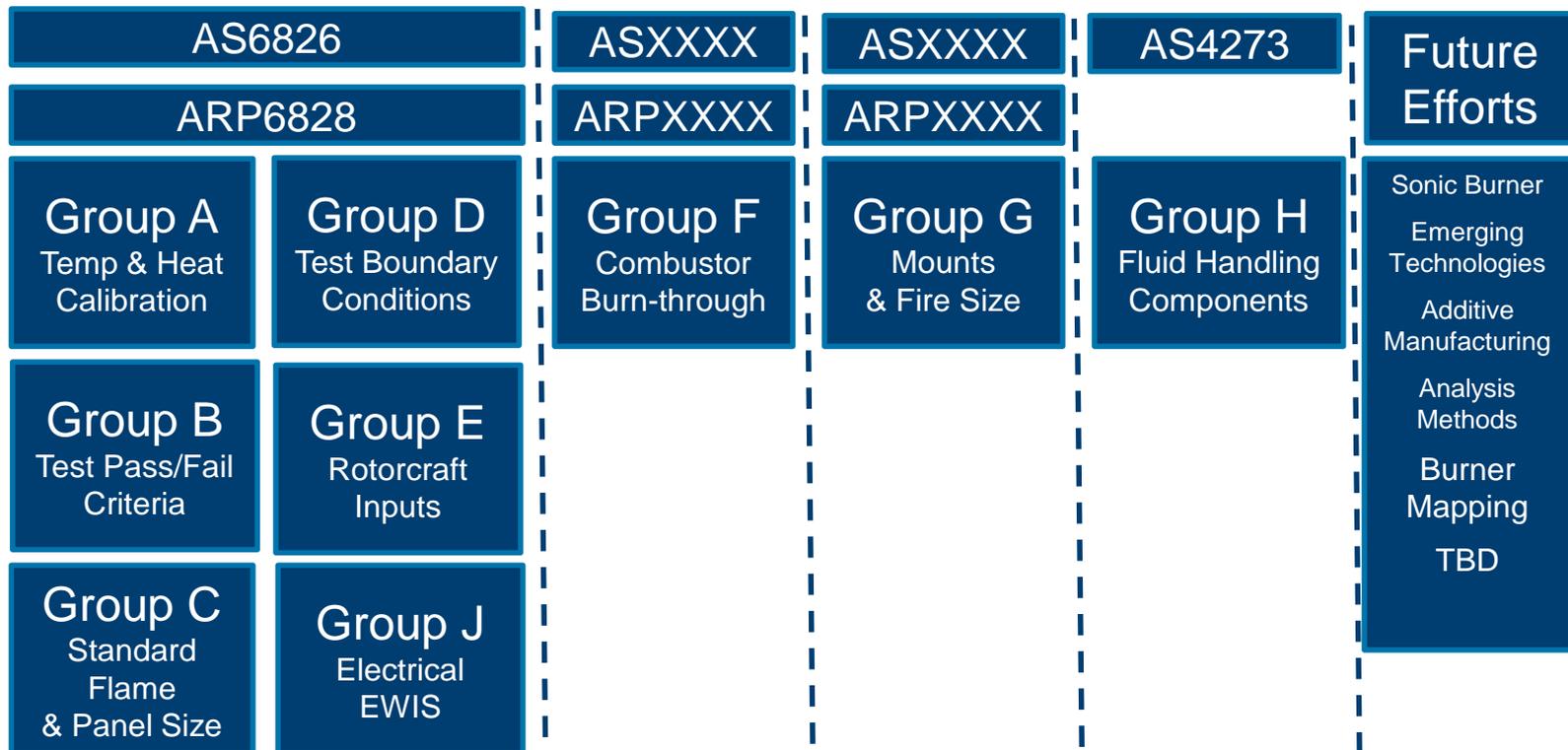
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Accufleet  
Aeroblaze  
CTA  
DGA  
Element  
Govmark  
Lefae-Emitech  
NIAR  
NTS  
Resonate



# SAE A-22 Committee Groups and Documents

Committee is Currently Organized into Groups to develop multiple Standards

- AS 6826 – Powerplant Fire Test Standard
- ARP 6828 – Powerplant Installation Level Fire Safety Assessment
- AS 4273 – Fire Testing of Fluid Handling Components for Aircraft Engines and Installations
- ARP or AS XXXX - Combustor Burn-through Guidance
- ARP or AS XXXX - Protection of Engine Mounts, Flight Controls, and Other Structure



# SAE A-22 Group Responsibilities and Efforts

## Group A

- Temperature Calibration
- Heat Flux Calibration
- TC and Instrumentation

## Group E

- Rotorcraft Input
- Harmonizing Flight Maneuver Loads During Fire Event

## Group B

- Post Test Burning
- Prescriptive Pass/Fail Criteria
- Industry Examples

## Group F

- Combustor Burn-Through Model
- Drafting MoCs for Hole Diameter & Shape, Case Pressure, etc.

## Group C

- Standard Flame
- Panel Size
- Burner Position/Orientation

## Group G

- Fire Protection of Engine Mounts, Flight Controls, and Other Structure
- Aligning Fire Protection and Certification Standards to 25.865

## Group D

- Environmental Boundary and Operating Conditions

## Group J

- Electrical/EWIS Regulations
- Fire Testing of Electrical Components

# AS6826 Powerplant Fire Test Standard: 2022 Significant Accomplishments

- Gathered and addressed ~250 comments
- Meeting this week to address remaining comments
- Added the test hood referenced in FAA Powerplant Report 3A and SAE AS1055
- Settled on thermocouple size, type, and construction specifications
- Improved the test calibration procedure flow
- Completed ~75% of the pass/fail criteria
- Completed ~75% of the boundary conditions



# AS6826 Powerplant Fire Test Standard: Significant Changes

- Pre-test calibration for heat transfer rate will use copper tube water apparatus
  - Apparatus design included in the Standard
  - No change to 4500 BTU/Hr minimum requirement
- Added post-test heat transfer rate validation
  - 4500 BTU/Hr minimum if copper tube can be cleaned
  - 4100 BTU/Hr minimum if copper tube cannot be cleaned
- Pre-test calibration for flame temperature will use rake of 7 thermocouples (TC), 1/16 inch (1.6 mm) nominal dia.
  - $2000 \pm 150^{\circ}\text{F}$  ( $1093 \pm 83^{\circ}\text{C}$ ) for each TC (no change)
  - $2000^{\circ}\text{F}$  ( $1093^{\circ}\text{C}$ ) minimum for average of 5 center TC (calc. excludes the 2 edge TC)
  - TC construction: ASTM E585/E585M-18 or IEC 61515
  - TC accuracy: IEC/BS EN 60584 or ASTM E230/E230-M12



Photo Courtesy of ACES



Photos Courtesy of Aeroblaze Labs

# AS6826 Powerplant Fire Test Standard: Significant Changes

- Existing legacy burners allowed, consistent with AC20-135 Change 1
- Sonic burner allowed if calibrated same as legacy burners
- Added instructions for defining boundary conditions
  - Loads, vibration, pressure, flow, etc.
  - Ground and flight conditions
- Pass/Fail criteria defined
  - Perform/maintain the fire-intended function
  - No burn-through, backside ignition, flame penetration
  - Residual flames on fire must be recorded and justified for acceptance; size and duration assessed
  - No flammable fluid leakage



Photo Courtesy of Eaton Aerospace

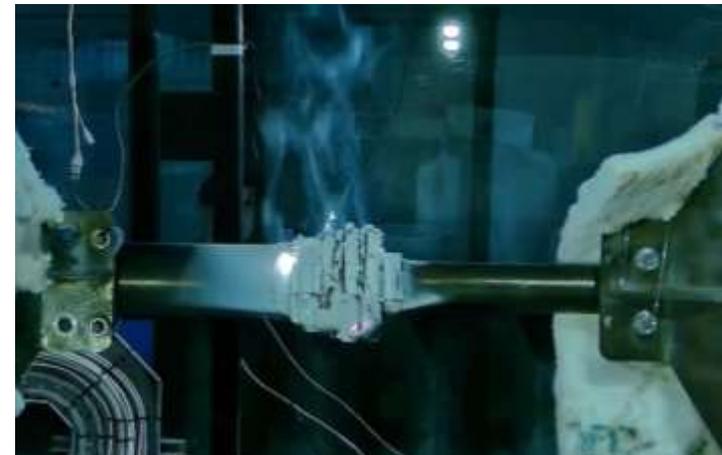
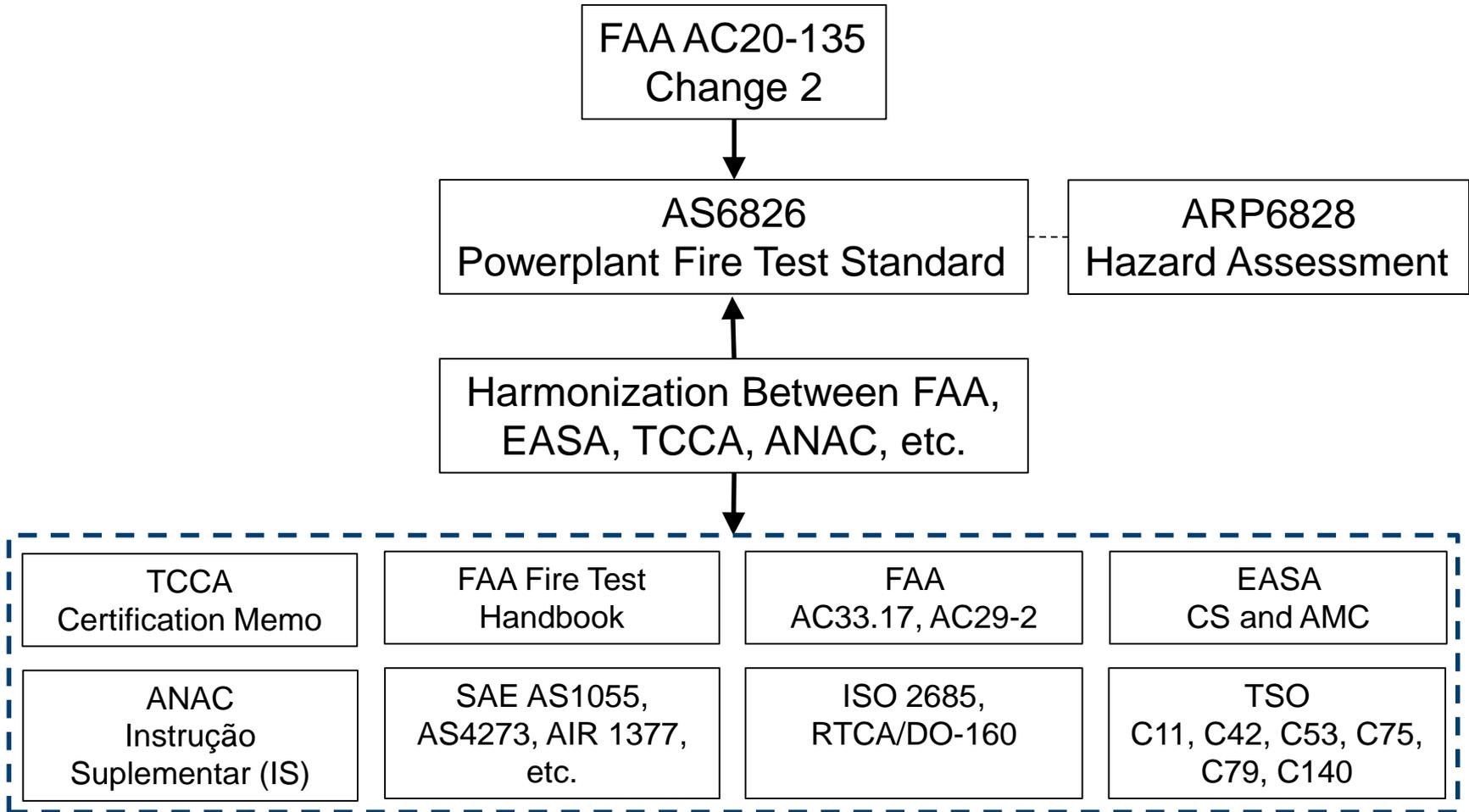


Photo Courtesy of Resonate

# AS6826 Fire Test Standard Implementation: AC20-135 and Other Updates



Note, the new AS6826 fire test standard is intended to provide acceptable means of compliance to be recognized by FAA AC20-135 (for example, similar to AC20-155A for Lightning Protection)

# SAE A-22 Fire Test Document – Roadmap & General Timelines

Are we there yet? Almost on AS6826...

**AS 6826**

- AS6826 initial release balloting: *3<sup>rd</sup> Quarter 2023*
- AS6826 document publication: *4<sup>th</sup> Quarter 2023*
- FAA AC20-135 and other Regulatory Authority document revisions to reflect AS6826: *2024 – 2025?*

**AS 4273**

- AS4273: *June 2023*
- Revise or stabilize document

**ARP 6828**

- ARP 6828 completion: *2023-2024*
- ARP 6828 balloting and publication: *2024*

**AS/ARP  
XXXX**

- Combustor burn-through
- Engine mounts
- EWIS

**...Plus future efforts – Sonic burner development, burner mapping ARP, emerging technologies...**